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NOTIFICATION OF ELECTION

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Applicant HAAPANIEMI, Jukka et al	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

07 September 1998 (07.09.98)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was [ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland** Facsimile No.: (41-22) 740.14.35	Authorized officer Aino Metcalfe Telephone No.: (41-22) 338.83.38

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A STRUCTURAL PLY OF A PAPERBOARD CORE, A PAPERBOARD CORE MADE THEREOF, AND A METHOD OF IMPROVING THE STIFFNESS OF A PAPERBOARD CORE

The present invention relates to a structural ply of a paperboard core, in accordance with the preamble of claim 1. The invention also relates to a spiral core comprising such a structural ply. Further, it relates to a method of improving the stiffness of a spiral paperboard core.

A spiral paperboard core is made up of a plurality of superimposed plies of paperboard by winding, glueing, and drying such.

Webs produced in the paper, film, and textile industries are usually reeled on cores for rolls. Cores made from paperboard, especially spiral cores are manufactured by glueing plies of paperboard one on top of the other and by winding them spirally in a special spiral machine. The width, thickness, and number of paperboard plies needed to form a core vary depending on the dimensions and strength requirements of the core to be manufactured. Typically, the ply width is 50 to 250 mm (in special cases about 500 mm), ply thickness about 0.2 to 1.2 mm, and the number of plies about 3 to 30 (in special cases about 50). The strength of a paperboard ply varies to comply with the strength requirement of the core. As a general rule, increasing the strength of a paperboard ply also increases its price. Generally speaking, it is therefore true to say that the stronger the core, the more expensive it is.

Paper reels used on printing presses are formed on a winding core. Almost always this winding core is a spirally wound paperboard core. In high efficiency printing presses, there is effected a so-called flying reel change towards the end of unwinding, i.e., the web for a new paper reel is joined at full speed to the web which

has been nearly unwound. A sufficiently firm and stiff core is a highly essential factor for the flying reel change to be successful.

Printing presses typically use cores of two sizes. The most usual core size has the inside diameter of 76 mm and the wall thickness of 13 or 15 mm. Today, the widest and fastest printing presses use cores with the inside diameter of 150 mm and the wall thickness of 13 mm. At the reel change, the minimum thickness of paper on the core is about 3 to 8 mm. If the core is not stiff enough, even much more paper has to be left thereon. Paperboard cores used at printing presses are typical cores of the paper industry, i.e., they are thick-walled, the wall thickness H being 10 mm or more and the inside diameter of the core being over 70 mm. Cores for the paper industry have to be thick-walled, i.e., the wall thickness has to be about 10 mm or more, e.g., in order to enable them to be clamped by chucks (chuck expansion) and in order to enable formation of a nip between the core surface and a backing roll, for the paper web to be reeled. Especially, the geometry of slitter-winders calls for a sufficient wall thickness of the cores, which is in practice 10 mm or more. Typically, such paper industry cores are used if the winding/unwinding speeds are at least about 200 m/min (=3.3 m/s).

If and, in practical circumstances, when the web speed of the printing press is not reduced for the reel change and when the size, i.e., the diameter of the paper reel diminishes during unwinding thereof, the speed of rotation of the diminishing reel increases to a considerably high rate.

The tendency has been towards wider and wider as well as faster and faster printing presses. Transferring to wide printing presses, i.e., those with long cores, and high running speeds, may result in that the rest reel, i.e.,

the paperboard core + the paper web to be left thereon, will get into its natural vibration range during the reel change, consequently shaking. This may lead to a costly web break or even to an explosion of the rest reel into pieces, thereby causing an extreme safety risk.

Such a situation is typical to wide and fast rotogravure presses. Rotogravure printing is a highly efficient printing mode, utilizing wide and fast printing presses and big reels. Also the fastest and widest catalogue presses may end up in a similar situation. With catalogue presses, this is partly also due to the fact that the stiffness factor of the paper roll supporting system, dependent on the chucks, is usually weaker than in high efficiency rotogravure presses.

In rotogravure presses, where the stability problem in unwinding is current, conditions are typically as follows.

With 2.45 m wide printing presses, cores with inside diameter of 76 mm are used. In special cases, when usually a larger amount of produced paper is required, printing presses of at most 2.65 m in width can be used together with cores having the inside diameter of 76 mm. If the rest reel were run near to the usual minimum amount of residual paper with these running parameters, the safety factor as to getting into the vibration range would be absolutely too small. In order that safe handling of the rest reel can be ensured, the amount of residual paper has to be grown from the earlier minimum of about 3 - 8 mm to as much as 15 mm. This naturally causes a great economic loss in form of wasted paper. The web speed at printing is here about 14 m/s.

When the inside diameter of the core is 150 mm, the printing press widths usually exceed the above values (cores having the inside diameter of 150 mm are, however,

applicable with the above printing press widths). The printing press widths are typically 3.08 m, 3.18 m, or 3.28 m. The printing speeds with these machines are the same as mentioned above.

The new generation of rotogravure presses will again be wider and faster than before, estimates of a combination of width and web speed of 3.68 m and 16 m/s or alternatively 3.08 m and 20 m/s or 3.18 m and 25 m/s have been presented. By early 1997, however, such new generation rotogravure presses have not yet been manufactured.

In the widest printing presses, which require a wider/faster web, the inside diameter of the core has been changed to 150 mm in order to solve the vibration problem. So far, this arrangement has functioned well. Now, the same problem as with earlier machines, until transferring to 150 mm cores, will be faced again with the running parameters of the new machines being designed. In other words, the risky range of natural vibration of the rest reel will be entered again.

For this reason, the stiffness of the core has to be grown in one way or another, in order that an increase in the inside diameter of the core could be avoided. The arrangement of increasing the inside diameter of the core has been considered a most undesirable solution in the production chain.

As discussed above, a spiral paperboard core is manufactured by winding narrow paperboard plies spirally around a mandrel. The paperboard of which the plies to be wound are cut off has been manufactured with a board machine. The selection of the interior and exterior plies of the core is usually (not always) based on other grounds than the selection of the structural plies. Therefore, the strength properties of the interior and exterior plies are

not often the same as those of other plies of the core. These other plies, usually located between the outer plies of the core, are called structural plies because their properties determine the final strength and quality class and other properties of the core. In those cases in which the end use of the core does not set any special demands on the exterior or interior plies (or under-exterior plies attached to them), the entire core may be constructed of these above-identified structural plies. In manufacturing of paperboard, it is an ambition to get its strength properties as homogeneous as possible. So-called squareness is the term used in this context, and its theoretical low limit, which is 1, is striven for. The longitudinal (= machine direction) strength of square paperboard as well as its elasticity modulus are the same as its corresponding values in the cross machine direction. In board machine arrangements of prior art, paperboard is, however, essentially stronger in the machine direction (typically 1.6 - 2.7 times stronger) than in the cross machine direction. This applies to the elasticity modulus of paperboard as well. As to the core stiffness, the axial stiffness factor of the core is determining. Due to the structure of a spirally wound core, the stiffness factor of paperboard in the machine direction (bigger) becomes more or less circumferential and the stiffness factor of paperboard in the cross machine direction (smaller) more or less axial.

By optimizing the ratio of paperboard in the machine direction to paperboard in the cross machine direction and by adjusting the structure of a spirally wound core (winding angles), it is possible to influence on the situation to some extent. However, with conventional board machines and conventional spiral machines, the chances are quite limited, and not adequate for solving the problem.

Rotogravure cores are divided into two categories in

accordance with their strength requirement, i.e., into a lower and a higher strength class. The elasticity moduli of conventional rotogravure cores of the lower strength class are on the level of 3300 to 4000 MPa. The elasticity moduli of commercial grades made from conventional materials but belonging to the higher strength class are on the level of 4200 to 4800 MPa. With special measures, these values can be marginally exceeded. The reel weights and printing press widths in rotogravure presses determine from which of the two strength classes paperboard cores are selected.

The levels of elasticity moduli of the raw materials for the core are dependent on the raw material for the paperboard ply to be used, on the manufacturing method, and on the orientation ratio (strength parameters of the ratio of paperboard in the machine direction to paperboard in the cross machine direction). The elasticity moduli of typical paperboard materials for rotogravure cores, which have expedient squareness, are about 6000 MPa in the machine direction and about 3000 MPa in the cross machine direction in the lower strength class. The corresponding values for the higher strength class materials are about 6500 to 7500 MPa in the machine direction and about 3500 to 4000 MPa in the cross machine direction.

An object of the present invention is to provide a structural ply of a novel type and improved applicability for a spiral paperboard core. Another object of the present invention is to provide a spiral paperboard core comprising at least one such structural ply and having improved strength properties. As the structural plies in accordance of the invention are superior to prior art structural plies, it is worthwhile optimizing their share of the core wall thickness and location in the core wall. As discussed above, the quality class of the raw materials for cores and consequently also the quality class of cores goes hand

in hand with the price paid/received for them.

A still further object of the present invention is to solve problems related to presently used spiral cores discussed above, and to provide a spiral paperboard core, which meets e.g. the strength requirements of cores, set by the running parameters of new printing presses. The arrangements according to the present invention are also applicable to other places where especially high stiffness is required.

These objects are achieved with the arrangements in accordance with the accompanying claims.

Based on tests we have performed, we have found that sufficiently strong cores are provided for printing presses of the new generation, and cores stronger than before are provided for existing printing presses when, in accordance with the present invention, the cross machine direction (CD) elasticity modulus E of a structural ply of a spiral paperboard core is substantially higher than 4500 MPa. Further, the machine direction (MD) elasticity modulus E of the structural ply is preferably substantially higher than 7500 MPa.

These new type paperboard cores of the present invention can be manufactured by using, either solely or partly, structural plies in accordance with the invention. The paperboard for these structural plies is manufactured, e.g., by what is called a press drying method.

Paperboard based on press drying can be manufactured by a board machine, utilizing a prior art process called Condebelt. Structural plies manufactured with other appropriate methods and meeting the strength requirements according to the invention can also be utilized in constructing a paperboard core.

As press drying is an efficient process, it is possible to increase the elasticity moduli of structural plies by that method, and the machine direction elasticity modulus of the above-mentioned structural plies of a rotogravure core of the lower strength class can be raised to a level of at least about 7500 - 10000 MPa, and with winding angles of 15 to 35° which are usually used, the elasticity modulus in the cross machine direction, which is very important, can be raised to a level of about 4500 - 5000 MPa. For example, the test result showing the elasticity modulus of 4800 MPa in the cross machine direction represents a fairly high standard in this strength class. As to cores of the higher strength level in accordance with the present invention, they correspond to the higher or better strength level of rotogravure cores. When structural plies according to the invention and manufactured from the better quality press drying material (e.g., with the so-called Condebelt method) are used, the machine direction elasticity modulus can be raised to a level of about 10000 - 12000 MPa, and the elasticity modulus in the cross machine direction to a level of about 5000 - 8000 MPa. Test results showing, e.g., the levels of structural ply elasticity moduli of 5500 MPa and 6500 MPa in the cross machine direction represent a fairly high standard in this strength class.

Use of the new structural ply as described in the invention meets the stiffness requirement of cores to be used in rotogravure presses of the new generation without a need to change the core structure in any other way except for the raw material.

Thus, the elasticity modulus of the cores of the presently used lower strength class cores can be raised to a level of at least about 5000 - 6000 MPa by utilizing arrangements of the invention. For example, a test result showing

the level of elasticity modulus of at least about 5500 MPa represents a fairly high standard in this strength class. The elasticity modulus of the higher strength class cores may be raised to a level of at least about 6000 - 6500 - 7000 MPa and even higher, which is adequate for meeting the requirements set by the new generation of rotogravure presses.

As can be seen, the values of the elasticity modulus of cores made up of paperboard plies according to the invention well suffice for the strength requirements of the above-mentioned rotogravure presses.

Use of paperboard cores according to the invention is not exclusively intended to the exemplified paperboard cores of the new generation of rotogravure presses. They may be used in every place where a higher stiffness is required of cores than usually. Such especially stiff cores are needed, for example, in rolling up carpets. Such carpet cores are subjected to especially long-lasting stresses because the carpet to be rolled around the core does not support the core, unlike e.g. in reeling paper. The inside diameter of the core can naturally be something else than the above-mentioned dimensions 76 and 150 mm, which are typical core diameters in rotogravure presses today.

By employing arrangements of the present invention in manufacturing rotogravure cores, the use range of cores having the inside diameter of 76 mm can be safely extended towards rotogravure presses, which are faster and wider than today. Thus, the arrangements according to the present invention provide answers to the challenges brought by completely new rotogravure presses as well as improve the economy of existing rotogravure presses.

Press drying (e.g. Condebelt) materials mentioned above may also be used together with conventional core boards to

provide a multigrade construction in situations where the elasticity modulus need not be quite as high and where it is desirable to save material due to either limited availability or costs. In such cases, a structural ply having a high elasticity modulus is used, e.g., in places where strength is a strategic factor, and conventional, prior art structural plies of adequate competence are used elsewhere.

The stiffness of a spirally wound multigrade paperboard core may be improved by constructing the core so that at least one of the structural plies is in accordance with the present invention, having the cross machine direction elasticity modulus of at least 4500 MPa. Further, it is especially advantageous that the machine direction elasticity modulus of the structural ply is at least 7500 MPa. Preferably, the share of structural plies in accordance with the invention is at least about 1/5 of the core wall thickness. Other potential structural plies may comply with prior art. As the structural plies of a paperboard core, in accordance with the invention, are superior to structural plies of prior art, it is worthwhile optimizing the share of the former of the core wall thickness as well as their location in the core wall. As discussed above, the quality class of core raw materials and consequently also the quality class of finished cores usually goes hand in hand with the price paid/received for them. Therefore, the optimization is well grounded both from the core manufacturer's and the customer's point of view.

A structural ply in accordance with the invention, a paperboard core made thereof, and a method of improving the stiffness of the paperboard core are described in greater detail in the following, by way of example, with reference to the accompanying drawings, in which

Fig. 1 shows graphically, as a function of the winding

angle α, elasticity modulus values for paperboard cores made up of different paperboard plies,

Fig. 2 illustrates the definition of the winding angle α, and

Fig. 3 illustrates the decreases in the inside diameter of a core, calculated with different winding angles α for two different types of paperboard.

Fig. 1 enclosed is a graphical illustration, presented as a function of a winding angle α (average winding angle), of elasticity modulus values of cores manufactured by using paperboard plies in accordance with the present invention, such cores being, e.g., rotogravure cores, used in the paper, film, and textile industries, said elasticity modulus values being compared with correspon-ding elasticity modulus values of prior art conventional cores of the higher strength class. As discussed above, with the winding angles of about 15 - 35°, which are usually used in spiral cores, the cross machine direction elasticity modulus is of highly essential effect on the total elasticity modulus of a finished spiral core. The definition of the winding angle α (average winding angle) of a paperboard ply, in connection with the present in-vention, is set forth in Fig. 2. The winding angle α (average winding angle) refers to the acute angle α between the direction transverse to the paperboard core axis and the edge of the paperboard ply. In Fig. 1, the three-point dashed line refers to a typical prior art rotogravure core of the lower strength class. The uniform dashed line again refers to a typical prior art rotogra-vure core of the higher strength class. In this core, the paperboard used as core material is as square as possible with regard to its orientation ratio, i.e., the numeric value of the orientation ratio is small. The dotted and dashed line refers to a rotogravure core constructed of

structural plies of the invention and the solid line to another rotogravure core made up of structural plies of the invention.

When reeling thin films or yarns around a spirally wound paperboard core, the material to be reeled causes a radial compression stress on the core, the inside diameter of the core becoming subject to the compression which provides a deformation therein, i.e., a decrease in the inside diameter of the core. In practical situations, this causes problems with certain types of winding chucks, when the core tends to stick thereto.

When reeling yarns around a spirally wound paperboard core or a yarn carrier, the reeling environment may still be wet, in practice. This adds to the tendency of the inside dimensions of the core to deform and the core to stick to the winding center.

We have discovered that it is possible to considerably weaken the tendency of the inside diameter of the core to decrease, by using structural plies according to the invention in constructing such cores, as can be seen from the accompanying Fig. 3.

Fig. 3 shows the decreases of the inside diameter of the core, calculated for two different paperboard grades by using different winding angles α (average winding angle). The orientation ratio of the paperboard commonly used today, which paperboard is marked with a circle, was about 1.6 in the test. The machine direction (MD) elasticity modulus was about 7000 MPa and the cross machine direction (CD) elasticity modulus about 3000 MPa. The orientation ratio of the paperboard manufactured by press drying (e.g. Condebelt paperboard), which paperboard is marked with a triangle, was about 1.8 in the test, and the machine direction (MD) elasticity modulus was about 11000 MPa, and

the cross machine direction (CD) elasticity modulus about 6000 MPa.

CLAIMS

1. A structural ply of a paperboard core, **characterized** in that the cross machine direction (CD) elasticity modulus E of the structural ply is substantially higher than 4500 MPa.

2. A structural ply as recited in claim 1, **characterized** in that the cross machine direction (CD) elasticity modulus E of the structural ply is higher than 4800 MPa and preferably higher than 5000 MPa.

3. A structural ply as recited in claim 1, **characterized** in that the cross machine direction (CD) elasticity modulus E of the structural ply is higher than 5500 MPa, preferably higher than 6000 MPa, and more preferably over 6500 MPa.

4. A structural ply as recited in any of the preceding claims 1 to 3, **characterized** in that the machine direction (MD) elasticity modulus E of the structural ply is further substantially higher than 7500 MPa.

5. A structural ply as recited in any of the preceding claims 1 to 3, **characterized** in that the machine direction (MD) elasticity modulus E of the structural ply is further substantially higher than 8000 MPa.

6. A structural ply as recited in any of the claims 1 to 5, **characterized** in that the structural ply is manufactured with a press drying method.

7. A paperboard core comprising a structural ply as recited in any of the preceding claims, the elasticity modulus E of the paperboard core being at least 5000 MPa, preferably over 5500 MPa, more preferably over 6000 MPa.

8. A spirally wound paperboard core, **characterized** in that the paperboard core comprises structural plies, the cross machine direction (CD) elasticity modulus of at least one of which structural plies is over 4500 MPa, preferably over 5000 MPa, and the machine direction (MD) elasticity modulus at least 7500 MPa, preferably over 8000 MPa.

9. A spirally wound paperboard core as recited in claim 8, **characterized** in that the paperboard core comprises structural plies, the total thickness of the structural plies being preferably at least 1/5 of the core wall thickness and the cross machine direction (CD) elasticity modulus of the structural plies being at least 4500 MPa, preferably over 5000 MPa, and the machine direction (MD) elasticity modulus of the structural plies being at least 7800 MPa, preferably over 8000 MPa.

10. A method of improving the stiffness of a spirally wound paperboard core, **characterized** in that the paperboard core is made up of structural plies, the cross machine direction (CD) elasticity modulus of at least one of which structural plies is at least 4500 MPa, preferably over 5000 MPa, and the machine direction (MD) elasticity modulus at least 7800 MPa, preferably over 8000 MPa.

11. A method as recited in claim 10, of improving the stiffness of a spirally wound paperboard core, **character-ized** in that the paperboard core is made up of structural plies the total thickness of the structural plies being preferably at least 1/5 of the core wall thickness and the cross machine direction (CD) elasticity modulus of the structural plies being at leat 4500 MPa, preferably over 5000 MPa, and the machine direction (MD) elasticity modulus at least 7800 MPa, preferably over 8000 MPa.

12. A paperboard core as recited in any of the preceding claims 7 to 9, **characterized** in that the paperboard core

is made up of structural plies, the machine direction elasticity modulus of the structural plies being at least 9000 MPa.

13. Use of a paperboard core as recited in any of the claims 7 to 9 as a yarn carrier.

14. Use of a paperboard core as recited in claim 12 as a yarn carrier.

15. Use of a paperboard core as recited in any of the claims 7 to 9 as a tube for thin films and foils.

16. Use of a paperboard core as recited in claim 12 as a tube for thin films and foils.

17. Use of a paperboard core as recited in claims 7 to 9 or in claim 12 as a thick-walled paper industry core, the wall thickness H thereof being at least 10 mm and the inside diameter over 70 mm, such cores being used with unwinding/winding speeds of at least about 200 m/min (= 3.3 m/s).

18. A core as recited in claims 7 to 9 or in claim 12, **characterized** in that the paperboard core is a thick-walled paper industry core, the wall thickness H thereof being at least 10 mm and the inside diameter over 70 mm, such cores being used with unwinding/winding speeds of at least about 200 m/min (= 3.3 m/s), the width of the paperboard ply located in the middle the core being
- with cores having the inside diameter of 73 mm to 110 mm,
at least 185 mm, preferably over 210 mm, and more preferably over 230 mm,
- with cores having the inside diameter of 111 mm to 144 mm,
at least 205 mm, preferably over 210 mm, and more prefer-

ably over 230 mm,

- with cores having the inside diameter of 145 mm to 180 mm,

at least 210 mm, preferably over 250 mm, and more preferably 350 mm to 450 mm,

- and with cores having the inside diameter of 181 mm to 310 mm,

at least 220 mm, preferably over 250 mm, and more preferably 350 to 500 mm, but

at most the maximum ply width L_{max} of each core of a certain width, where $L_{max} = (\pi) \times$ (core diameter in the specific point).

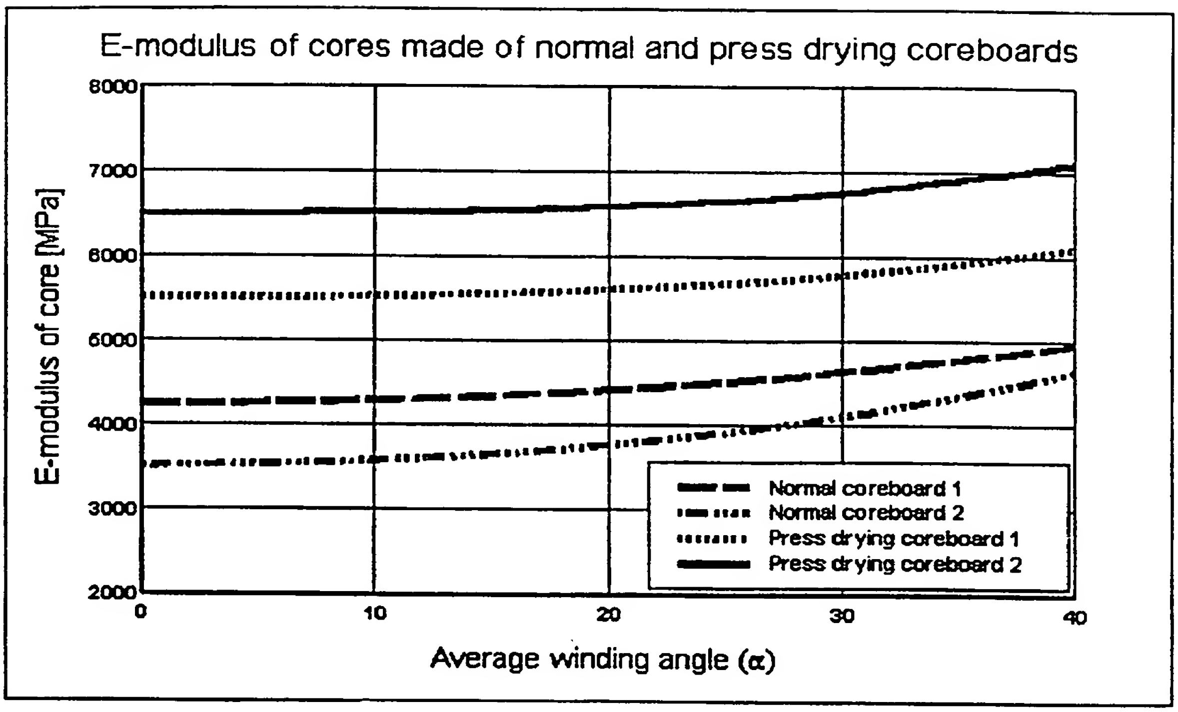
E-modulus of cores made of normal and press drying coreboards
E-modulus of core [MPa]
8000
7000
6000
5000
4000
3000
2000
0
10
20
30
40
Average winding angle (α)
Normal coreboard 1
Normal coreboard 2
Press drying coreboard 1
Press drying coreboard 2

FIG. 1

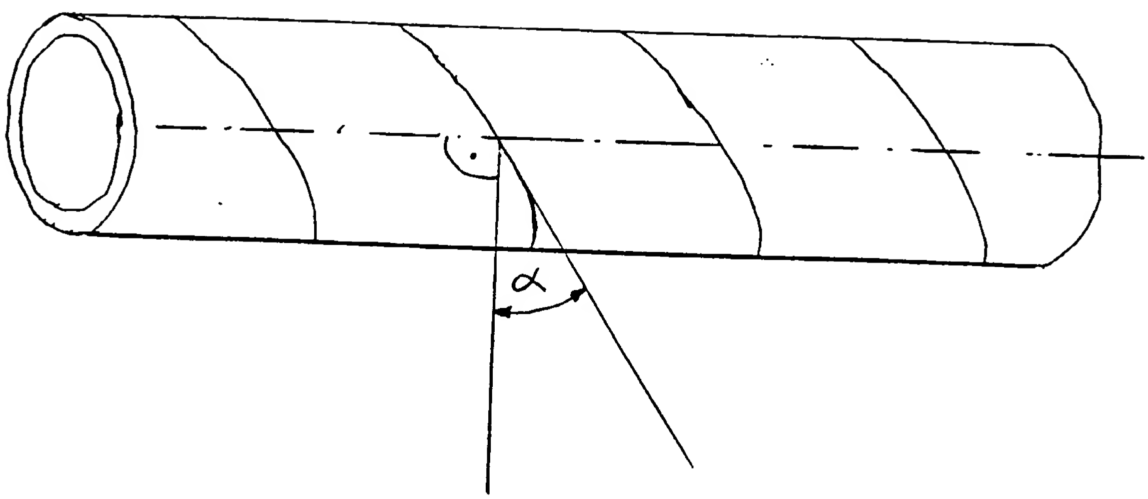

FIG. 2

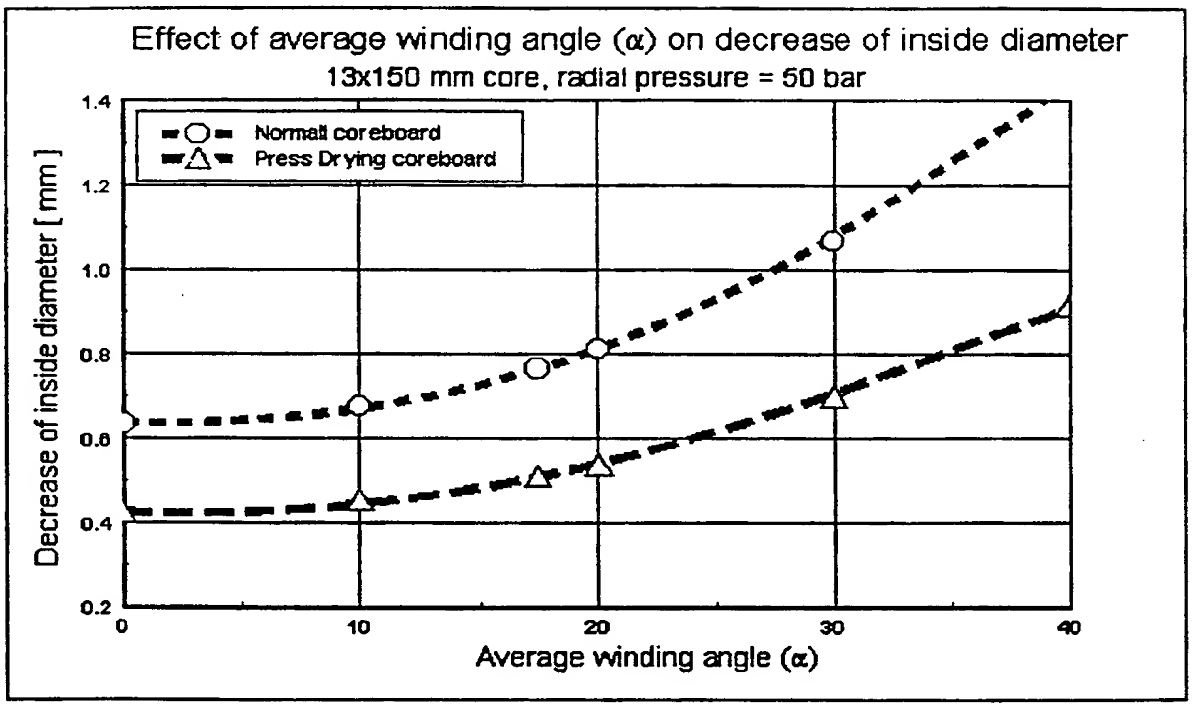
Effect of average winding angle (α) on decrease of inside diameter
13x150 mm core, radial pressure = 50 bar
Normal coreboard
Press Drying coreboard
Decrease of inside diameter [mm]
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
10
20
30
40
Average winding angle (α)

FIG.3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 98/00061

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B31C 3/00, B65H 75/02
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B31C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5505395 A (QIU ET AL.), 9 April 1996 (09.04.96), column 5, line 25 - column 11, line 52, figures 1-4 --	1-18
A	US 4874469 A (PULKOWSKI ET AL.), 17 October 1989 (17.10.89), figure 7, abstract --	6
A	US 4675079 A (WEBSTER), 23 June 1987 (23.06.87), figure 1, abstract --	6
A	US 5167994 A (PAULSON), 1 December 1992 (01.12.92), figure 1, abstract --	1-18

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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30 June 1998	01-07- 1998
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 98/00061

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0631963 A1 (SONOCO PRODUCTS COMPANY), 4 January 1995 (04.01.95), figure 1, abstract --	1-18
A	EP 0627306 A1 (SONOCO PRODUCTS COMPANY), 7 December 1994 (07.12.94), figure 1, abstract --	1-18
A	WO 9519930 A1 (SONOCO PRODUCTS COMPANY), 27 July 1995 (27.07.95), figures 1-4, abstract -- --------	1-18

INTERNATIONAL SEARCH REPORT

Information on patent family members

09/06/98

International application No.
PCT/FI 98/00061

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5505395 A	09/04/96	EP 0740640 A	06/11/96
		WO 9519930 A	27/07/95
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		US 5393582 A	28/02/95
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		US 5505395 A	09/04/96
WO 9519930 A1	27/07/95	EP 0740640 A	06/11/96
		US 5505395 A	09/04/96

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REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

International Application No. PCT/FI 98/00061

International Filing Date 23 JAN 1998 (23.01.98)

The Finnish Patent Office
PCT International Application
Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference (*if desired*) (*12 characters maximum*) P1399

Box No. I TITLE OF INVENTION

A structural ply of a paperboard core, a paperboard core made thereof, and a method of improving the stiffness of a paperboard core

Box No. II APPLICANT

Name and address: (*Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.*)

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Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: (*Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.*)

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This person is:
☐ applicant only
☒ applicant and inventor
☐ inventor only (*If this check-box is marked, do not fill in below.*)

State (*i.e. country*) of nationality: FI

State (*i.e. country*) of residence: FI

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☒ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: (*Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.*)

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☐ Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Continuation of Box No. III **FURTHER APPLICANTS AND/OR (FURTHER) INVENTORS**

If none of the following sub-boxes is used, this sheet is not to be included in the request.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

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This person is:
- [ ] applicant only
- [X] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality: FI

State *(i.e. country)* of residence: FI

This person is applicant for the purposes of: [ ] all designated States [ ] all designated States except the United States of America [X] the United States of America only [ ] the States indicated in the Supplemental Box

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Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

This person is:
- [ ] applicant only
- [ ] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality:

State *(i.e. country)* of residence:

This person is applicant for the purposes of: [ ] all designated States [ ] all designated States except the United States of America [ ] the United States of America only [ ] the States indicated in the Supplemental Box

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Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

This person is:
- [ ] applicant only
- [ ] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality:

State *(i.e. country)* of residence:

This person is applicant for the purposes of: [ ] all designated States [ ] all designated States except the United States of America [ ] the United States of America only [ ] the States indicated in the Supplemental Box

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Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

This person is:
- [ ] applicant only
- [ ] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality:

State *(i.e. country)* of residence:

This person is applicant for the purposes of: [ ] all designated States [ ] all designated States except the United States of America [ ] the United States of America only [ ] the States indicated in the Supplemental Box

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[ ] Further applicants and/or (further) inventors are indicated on another continuation sheet.

Box No.V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) *(mark the applicable check-boxes; at least one must be marked)*:

Regional Patent

- [x] **AP** **ARIPO Patent:** GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, SD Sudan, SZ Swaziland, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- [x] **EA** **Eurasian Patent:** AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- [x] **EP** **European Patent:** AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- [x] **OA** **OAPI Patent:** BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* ....

National Patent *(if other kind of protection or treatment desired, specify on dotted line)*:

- [x] **AL** Albania
- [x] **AM** Armenia
- [x] **AT** Austria
- [x] **AU** Australia
- [x] **AZ** Azerbaijan
- [x] **BA** Bosnia and Herzegovina
- [x] **BB** Barbados
- [x] **BG** Bulgaria
- [x] **BR** Brazil
- [x] **BY** Belarus
- [x] **CA** Canada
- [x] **CH and LI** Switzerland and Liechtenstein
- [x] **CN** China
- [x] **CU** Cuba
- [x] **CZ** Czech Republic
- [x] **DE** Germany
- [x] **DK** Denmark
- [x] **EE** Estonia
- [x] **ES** Spain
- [x] **FI** Finland
- [x] **GB** United Kingdom
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- [x] **GH** Ghana
- [x] **GM** Gambia
- [x] **GW** Guinea-Bissau
- [x] **HU** Hungary
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- [x] **IL** Israel
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- [x] **KP** Democratic People's Republic of Korea
- [x] **KR** Republic of Korea
- [x] **KZ** Kazakhstan
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- [x] **LR** Liberia
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- [x] **LT** Lithuania
- [x] **LU** Luxembourg
- [x] **LV** Latvia
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- [x] **MG** Madagascar
- [x] **MK** The former Yugoslav Republic of Macedonia
- [x] **MN** Mongolia
- [x] **MW** Malawi
- [x] **MX** Mexico
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Check-boxes reserved for designating States (for the purposes of a national patent) which have become party to the PCT after issuance of this sheet:

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- [ ] ....
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In addition to the designations made above, the applicant also makes under Rule 4.9(b) all designations which would be permitted under the PCT except the designation(s) of ______

The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. *(Confirmation of a designation consists of the filing of a notice specifying that designation and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.)*

Box No. VI PRIORITY CLAIM — Further priority claims are indicated in the Supplemental Box ☐

The priority of the following earlier application(s) is hereby claimed:

Country *(in which, or for which, the application was filed)*	Filing Date *(day/month/year)*	Application No.	Office of filing *(only for regional or international application)*
item (1) FI	14 February 1997 (14.02.97)	970646	
item (2) FI	14 February 1997 (14.02.97)	U970081	
item (3)			

Mark the following check-box if the certified copy of the earlier application is to be issued by the Office which for the purposes of the present international application is the receiving Office (a fee may be required):

☐ The receiving Office is hereby requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) identified above as item(s) : ______

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(If two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):* ISA / SE

Earlier search *Fill in where a search (international, international-type or other) by the International Searching Authority has already been carried out or requested and the Authority is now requested to base the international search, to the extent possible, on the results of that earlier search. Identify such search or request either by reference to the relevant application (or the translation thereof) or by reference to the search request:*

Country (or regional Office): Date *(day/month/year)*: Number:

Box No. VIII CHECK LIST

This international application contains the following number of sheets:

1. request	:	4	sheets
2. description	:	12	sheets
3. claims	:	4	sheets
4. abstract	:	1	sheets
5. drawings	:	3	sheets
Total	:	24	sheets

This international application is accompanied by the item(s) marked below:

1. ☐ separate signed power of attorney
2. ☒ copy of general power of attorney
3. ☐ statement explaining lack of signature
4. ☐ priority document(s) *identified in Box No. VI as item(s):*
5. ☒ fee calculation sheet
6. ☐ separate indications concerning deposited microorganisms
7. ☐ nucleotide and/or amino acid sequence listing (diskette)
8. ☐ other *(specify)*:

Figure No. 1 of the drawings (if any) should accompany the abstract when it is published.

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

AHLSTROM MACHINERY OY

Jukka Haapaniemi

Jukka Haapaniemi, agent

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1. Date of actual receipt of the purported international application: 23 JAN 1998 (23-01-1998)
2. Drawings: ☐ received: ☐ not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:
4. Date of timely receipt of the required corrections under PCT Article 11(2):
5. International Searching Authority specified by the applicant: ISA / SE
6. ☐ Transmittal of search copy delayed until search fee is paid

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Date of receipt of the record copy by the International Bureau: 16 FEBRUARY 1998 (16.02.98)

KARTONKIHYLSYN RAKENNENAUHA, SIITÄ VALMISTETTU KARTONKIHYLSY JA MENETELMÄ KARTONKIHYLSYN JÄYKKYYDEN PARANTAMISEKSI

Esillä olevan keksinnön kohteena on patenttivaatimuksen 1 johdanto-osan mukainen kartonkisen kierrehylsyn rakennenauha. Tällaisen rakennenauhan sisältävä kierrehylsy on myös keksinnön kohteena. Esillä oleva keksintö kohdistuu lisäksi menetelmään kartonkisen kierrehylsyn jäykkyyden parantamiseksi.

Kartonkinen kierrehylsy muodostetaan päällekkäisistä kartonkinauhakerroksista kelaamalla, liimaamalla ja kuivaamalla.

Valmistettaessa rainoja paperi-, muovi- ja tekstiiliteollisuudessa ne rullataan yleensä rulliksi, jolloin rullaussydämenä käytetään hylsyä. Kartonkisia hylsyjä, erityisesti kierrehylsyjä, valmistetaan liimaamalla kartonkinauhoja toistensa päälle kiertämällä ne spiraalimaisesti erityisessä hylsykoneessa. Hylsyyn käytettävien kartonkinauhojen leveydet, paksuudet ja lukumäärät vaihtelevat valmistettavan hylsyn mittojen ja lujuusvaatimusten mukaan, ja nauhaleveys on tyypillisesti 50 - 250 mm (erityistapauksissa n. 500 mm), nauhapaksuus n. 0,2 - 1,2 mm ja nauhalukumäärä n. 3 - 30 kpl (erityistapauksissa n. 50 kpl). Kartonkinauhan lujuus vaihtelee hylsyltä vaadittavan lujuuden mukaan. Pääsääntöisesti kartonkinauhan lujuuden kasvattaminen kasvattaa myös sen hintaa. Näin ollen pitää yleisesti paikkansa toteamus, että mitä lujempi hylsy sitä kalliimpi hylsy.

Painokoneilla käytettävät paperirullat valmistetaan rullauspohjan päälle. Tämä rullauspohja on lähes aina kartonkinen kierrehylsy. Suuritehoisilla painokoneilla tyhjentyvälle paperirullalle tehdään ns. lentävä vaihto,

eli tyhjenevän rullan rataan liitetään täydessä vauhdissa uuden paperirullan rata. Riittävän luja ja jäykkä hylsy on erittäin oleellinen tekijä, jotta rullanvaihto tällä ns. lentävällä vaihdolla onnistuu.

Painokoneilla hylsyt ovat tyypillisesti kahta kokoa. Yleisin koko on sisähalkaisijaltaan n. 76 mm ja seinämävahvuudeltaan 13 tai 15 mm. Leveimmillä ja nopeimmilla painokoneilla käytetään nykyään hylsyjä, joiden sisähalkaisija on 150 mm ja seinämävahvuus 13 mm. Rullanvaihtotilanteessa hylsyn päällä on paperia minimissään n. 3 - 8 mm. Jollei hylsy ole tarpeeksi jäykkä, joudutaan paperia jättämään huomattavastikin enemmän. Painokoneilla käytettävät kartonkiset hylsyt ovat tyypillisiä paperiteollisuushylsyjä, jotka paperiteollisuushylsyt ovat paksuseinämäisiä, seinämänvahvuus H on 10 mm tai yli ja sisähalkaisija yli 70 mm. Paperiteollisuushylsyt on konstruoitava seinämänvahvuudeltaan paksuiksi eli seinämänvahvuudeltaan n. 10-millimetriseksi tai yli, jotta mm. niiden istukkakiinnitys (istukan paisunta) mahdollistuu ja jotta rullattavalle paperirainalle saadaan muodostettua nippi hylsyn pinnan ja vastatelan väliin. Erityisesti kiinnirullauslaitteiden ja pituusleikkureiden geometria vaatii hylsyltä riittävää seinämänvahvuutta, joka on käytännössä 10 mm tai yli. Tällaisia paperiteollisuushylsyjä käytetään tyypillisesti auki/kiinnirullausnopeuksilla, jotka ovat vähintään n. 200 m/min (= 3,3 m/s).

Jos ja käytännön olosuhteissa kun painokoneen ratanopeutta ei rullanvaihtoa varten hidasteta ja kun paperirullan koko eli sen halkaisija pienenee paperirullaa aukirullattaessa, nousee pienentyvän rullan pyörimisnopeus varsin korkeaksi.

Kehityksen suuntana on ollut siirtyminen yhä leveämpiin ja nopeampiin painokoneisiin. Kun siirrytään leveisiin painokoneisiin ts. pitkiin hylsyihin ja nopeisiin ajoar-

voihin, saattaa rullanvaihtoon liittyvissä olosuhteissa loppurulla, ts. kartonkihylsy + sen päälle jätettäväksi tarkoitettu paperirata joutua ominaisvärähtelyalueelleen ja täristä aiheuttaen kalliin ratakatkon tai jopa räjähtää kappaleiksi aiheuttaen äärimmäisen turvallisuusriskin.

Tällainen tilanne syntyy tyypillisimmillään leveillä ja nopeilla syväpainokoneilla. Syväpainatus on erittäin tehokas painatusmenetelmä, missä painokoneet ovat leveitä ja nopeita sekä rullat suuria. Myös nopeimmilla ja leveimmillä luettelopainokoneilla saattaa syntyä vastaavanlainen tilanne. Tämä johtuu osittain myös siitä, että luettelopainokoneiden yhteydessä paperirullan ripustuksen kiinnitysistukoista riippuvainen jäykkyystekijä on yleensä hyviä syväpainokoneita heikompi.

Syväpainokoneilla, joilla aukirullauksen stabiilisuusongelma on ajankohtainen, olosuhteet ovat tyypillisesti seuraavanlaiset.

Painokoneiden leveyden ollessa 2,45 m käytetään hylsyjä, joiden sisähalkaisija on 76 mm. Erityistapauksissa, jolloin yleensä loppupaperin määrän on oltava suurempi, voidaan käyttää enintään 2,65 m leveitä painokoneita yhdessä sisähalkaisijaltaan 76 mm hylsyjen kanssa. Jos loppurulla näillä ajoparametreilla ajettaisiin lähelle normaalia minimijäännöspaperimäärää, jäisi varmuuskerroin värähtelyalueelle joutumisen suhteen aivan liian pieneksi. Jotta loppurullan turvallinen käsitteleminen voidaan varmistaa, joudutaan jäännöspaperin määrää kasvattamaan turvallisuussyistä aiemmin käytetystä minimistään, n. 3 - 8 mm:stä jopa 15 mm:iin. Tästä aiheuttuu luonnollisesti suuri taloudellinen tappio paperihävikin muodossa. Painatuksen ratanopeus on tällöin n. 14 m/s.

Hylsyn sisähalkaisijan ollessa 150 mm painokoneleveydet ovat tavallisesti yli edellä mainittujen lukujen (voidaan kuitenkin myös käyttää sisähalkaisijaltaan 150 mm:n hylsyä edellä mainituilla painokoneleveyksillä). Painokoneleveydet ovat tyypillisesti 3,08 m, 3,18 m tai 3,28 m. Painatusnopeudet näillä koneilla ovat samat kuin edellä on mainittu.

Syväpainokoneiden uusin sukupolvi tulee taas olemaan entistä leveämpi ja nopeampi, puhutaan leveys/ratanopeus-yhdistelmästä 3,68 m ja 16 m/s tai vaihtoehtoisesti leveys/ratanopeus-yhdistelmästä 3,08 m tai 3,18 m ja 20 - 25 m/s. Tällaisia uuden sukupolven syväpainokoneita ei vielä vuoden 1997 alkupuoleen mennessä ole valmistettu.

Hylsyn sisähalkaisija on aiempien, suurempaa leveyttä/nopeutta vaativien painokoneiden johdosta muutettu leveimmille koneille 150 mm:iin aukirullauksen värähtelyongelman ratkaisemiseksi. Tämä ratkaisu on toiminut tähän asti hyvin. Nyt kuitenkin uusien suunnitteilla olevien koneiden ajoparametrien kanssa tullaan jälleen törmäämään samaan ongelmaan kuin aiemmilla koneilla ennen sisähalkaisijaltaan 150 mm:n hylsyihin siirtymistä eli tullaan loppurullan ominaisvärähtelyn riskialueelle.

Tästä syystä hylsyn jäykkyyttä on tavalla tai toisella saatava kasvatettua, jotta uudelta hylsyn sisämitan kasvattamiselta vältyttäisiin. Hylsyn sisämitan kasvattaminen on koettu tuotantoketjussa hyvin vastenmieliseksi ratkaisuksi.

Kuten jo aiemmin todettiin, kartonkinen kierrehylsy valmistetaan kelaamalla kapeita kartonkinauhoja spiraalimaisesti akselin ympärille. Kartonki, josta kelattavat nauhat leikataan, on valmistettu kartonkikoneella. Kartonkihylsyn pohja- ja pintanauhat valitaan yleisesti

(ei aina) muilla perusteilla kuin rakennenauhat, jolloin niiden lujuusarvot eivät useinkaan ole samat kuin muilla hylsyn nauhoilla. Näitä muita, yleensä hylsyn ulkopintojen väliin jääviä nauhoja kutsutaan rakennenauhoiksi, sillä niiden ominaisuudet ratkaisevat hylsyn lopullisen lujuus-laatuluokan ym. ominaisuudet. Niissä tapauksissa, joissa pinta- tai pohjanauhalla (ja niihin liittyvillä pinnanalusnauhoilla) ei ole hylsyn loppukäytön kannalta erityisvaatimuksia, voidaan koko hylsy konstruoida näistä edellämainituista rakennenauhoista. Yleisesti kartonki pyritään valmistamaan lujuusominaisuuksiltaan mahdollisimman homogeeniseksi. Puhutaan ns. neliömäisyydestä, jonka arvo pyritään saamaan mahdollisimman lähelle sen teoreettista alaraja-arvoa, joka on 1. Neliömäisen kartongin pituussuuntainen (=koneensuuntainen) lujuus ja samalla sen kimmomoduuli on sama kuin kartongin vastaavat poikittaiset arvot. Tunnetuilla kartonkikoneratkaisuilla kartongin pituussuunta on kuitenkin oleellisesti (tyypillisesti 1,6 - 2,7 kertaa, huonoimmassa tilanteessa jopa 4,5 kertaa) lujempi kuin sen poikkisuunta. Tämä pätee myös kartongin kimmomoduuliin. Hylsyn jäykkyyden kannalta hylsyn akselin suuntainen jäykkyystekijä on määräävä. Spiraalihylsyn rakenteesta johtuen kartongin konesuunnan jäykkyystekijä (=suurempi) joutuu lähinnä kehänsuuntaan ja kartongin poikkisuunnan jäykkyystekijä (=pienempi) joutuu lähinnä hylsyn akselin suuntaan.

Kartongin pituus/poikkisuhdetta optimoimalla ja kierrehylsyn rakennetta (nauhakulmia) säätämällä tilanteeseen on mahdollista jonkin verran vaikuttaa. Kuitenkin tavanomaisilla kartonkikoneilla ja tavanomaisilla kierrehylsykoneilla vaikutusmahdollisuudet ovat varsin rajalliset, eivätkä riitä ongelmaa ratkaisemaan.

Käytetyt syväpainohylsyt jaetaan lujuusvaatimusluokan mukaan yleisesti kahteen luokkaan: ns. alempaan lujuusvaa-

timusluokkaan ja parempaan lujuusvaatimusluokkaan. Tavanomaiset alemman lujuusvaatimusluokan syväpainohylsyn kimmomoduulit ovat tasolla 3.300 - 4.000 MPa ja paremman lujuusvaatimusluokan, tavanomaisista materiaaleista tehtyjen kaupallisten lajien tasolla 4.200 - 4.800 MPa. Erikoistoimilla päästään marginaalisesti yli näiden arvojen. Syväpainokoneissa käytettävät rullapainot ja painokoneleveydet määräävät sen kumpaan lujuusvaatimusluokkaan kuuluvia kartonkihylsyjä käytetään.

Hylsyn raaka-aineiden kimmomoduulitasot ovat riippuvia käytetyn kartonkinauhan raaka-aineesta, valmistusmenetelmästä ja orientaatiosuhteesta (kartongin pituus/poikkisuhteen lujuusparametrit). Tyypillisen hyvän neliömäisyyden omaavan hylsykartongin kone- ja poikkisuuntien kimmomoduulit ovat alemman lujuusvaatimusluokan syväpainohylsymateriaaleilla konesuunnassa n. 6000 MPa ja poikkisuunta n. 3000 MPa. Paremman lujuusvaatimusluokan materiaaleilla vastaavat luvut ovat konesuunnassa n. 6.500 - 7.500 MPa ja poikkisuunnassa n. 3.500 - 4.000 MPa.

Esillä olevan keksinnön tarkoituksena on aikaansaada uudentyyppinen käyttöominaisuuksiltaan parannettu kartonkisen kierrehylsyn rakennenauha. Esillä olevan keksintömme tarkoituksena on myös aikaansaada ainakin yhden tällaisen rakennenauhan sisältävä, lujuusarvoiltaan parannettu, kartonkinen kierrehylsy. Koska keksinnön mukaiset kartonkihylsyn rakennenauhat ovat parempia kuin nykyisin tunnetut rakennenauhat, kannattaa niiden osuus hylsynseinämän paksuudesta ja sijainti hylsynseinämässä optimoida. Kuten aiemmin on todettu, kulkee yleensä käytettyjen hylsyraaka-aineiden laatuluokka ja siten myös hylsyjen laatuluokka käsi kädessä niistä maksettavan/saatavan hinnan kanssa.

Esillä olevan keksintömme tarkoituksena on myös ratkaista edellä esitettyihin, nykyisin käytössä oleviin, kierrehylsyihin liittyviä ongelmia ja siten aikaansaada sellainen kartonkinen kierrehylsy, joka täyttää esim. uusien painokoneiden ajoparametrien hylsyille asettamat lujuusvaatimukset. Keksintömme mukaiset ratkaisut sopivat myös muihin erityisen suurta jäykkyyttä vaativiin käyttökohteisiin.

Tämä tarkoitus saavutetaan oheisten patenttivaatimusten mukaisella ratkaisulla.

Suorittamiemme kokeiden perusteella olemme havainneet, että uuden sukupolven painokoneille saadaan riittävän lujia hylsyjä ja olemassa oleville painokoneille saadaan aiempaa paremman lujuuden omaavia hylsyjä, kun esillä olevan keksinnön mukaisesti kartonkisen kierrehylsyn rakennenauhan poikittaissuuntainen (CD) kimmomoduuli E on olennaisesti suurempi kuin 4500 MPa. Rakennenauhan konesuuntainen (MD) kimmomoduuli E on lisäksi edullisesti olennaisesti suurempi kuin 7500 MPa.

Näitä keksinnön mukaisia uudentyyppisiä kartonkihylsyjä voidaan valmistaa käyttämällä hylsyn valmistuksessa joko yksinomaan tai osittain keksinnön mukaisia rakennenauhoja, joihin käytetty kartonki on valmistettu esim. ns. puristuskuivausmenetelmällä (ns. press drying).

Puristuskuivausmenetelmään (press drying) perustuvaa kartonkia voidaan valmistaa esim. erästä tunnettua, ns. Condebelt-prosessia hyödyntävällä kartonkikoneella. Myös muilla sopivilla menetelmillä valmistettuja, keksinnön mukaiset lujuusvaatimukset täyttäviä, kartonkihylsyn rakennenauhoja voidaan käyttää hyväksi kartonkihylsyn konstruoinnissa.

Puristuskuivausmenetelmällä (press drying -menetelmällä) voidaan rakennenauhan kimmomoduuleita nostaa tehokkaan puristuskuivausprosessin ansiosta ja edellä mainituille tavanomaisen syväpainohylsyn alempaa lujuusvaatimustasoa vastaaville rakennenauhoille saadaan konesuunnan kimmomoduuli nostettua ainakin tasolle n. 7500 - 10 000 MPa ja tavanomaisesti käytetyillä kierrehylsyn nauhakulmilla, n. 15 - 35°, niin tärkeän rakennenauhan poikkisuunnan kimmomoduulin arvo nostettua tasolle n. 4500 - 5000 MPa. Esim. koetulos, jossa poikkisuunnan kimmomoduulille saatiin arvo 4800 MPa edustaa hyvää tasoa tässä lujuusvaatimusluokassa. Syväpainohylsyjen ns. ylempää tai parempaa lujuustasoa vastaa myös keksinnön mukaiset paremman lujuustason hylsyt. Keksinnön mukaisilla, puristuskuivatusta paremman laatuluokan puristuskuivausmateriaalista (esim. ns. Condebelt-menetelmällä) valmistetuilla rakennenauhoilla konesuunnan kimmomoduulitaso saadaan nostettua tasolle n. 10 000 - 12 000 MPa ja poikkisuunnan kimmomoduulitaso tasolle n. 5000 - 8.000 MPa. Esim. koetulokset, joissa on saavutettu 5500 MPa:n ja 6500 MPa:n kimmomoduulitaso rakennenauhan poikkisuunnalle edustavat hyvää tasoa tässä lujuusvaatimusluokassa.

Keksinnössä kuvatun uuden rakennenauhamateriaalin käyttö ratkaisee uuden sukupolven syväpainokoneiden yhteydessä käytettävän hylsyn jäykkyysvaatimuksen ilman, että hylsyn rakennetta muutoin kuin raaka-aineen osalta tarvitsee muuttaa.

Tällöin syväpainoteollisuuden nykyisin käyttämän alemman lujuusvaatimusluokan hylsyn kimmomoduulitaso saadaan keksinnön mukaisia ratkaisuja hyödyntämällä nostettua ainakin tasolle n. 5000 - 6000 MPa. Esim. koetulos, jossa on saavutettu 5500 MPa:n kimmomoduulitaso hylsylle edustaa hyvää tasoa tässä lujuusvaatimusluokassa. Ylemmän lujuusvaatimusluokan hylsyjen kimmomoduulitaso voidaan puoles-

taan keksinnön mukaisia ratkaisuja hyödyntämällä nostaa ainakin tasolle n. 6000-6500-7000 MPa ja ylikin, joka on riittävä uuden sukupolven syväpainokoneiden asettamille vaatimuksille.

Keksinnön mukaisista kartonkinauhoista konstruoitujen hylsyjen kimmomoduuliarvot riittävät siten mainiosti täyttämään edellä mainittujen uusien syväpainokoneiden asettamat lujuusvaatimusluokitukset.

Keksinnön mukaisten kartonkihylsyjen käyttö ei ole rajoitettu vain esimerkkinä mainittuihin uuden sukupolven syväpainokoneissa käytettäviin kartonkihylsyihin. Niitä voidaan käyttää kaikkialla missä tarvitaan hylsyltä tavanomaista suurempaa jäykkyyttä. Tällaisia erityisen jäykkiä hylsyjä tarvitaan rullattaessa esim. mattoja. Tällaisiin ns. mattohylsyihin kohdistuu erityisen pitkäaikaisia staattisia jännityksiä, koska hylsyn päälle rullattava matto ei tue hylsyä, kuten esim. paperia rullattaessa. Myöskin hylsyn sisähalkaisija voi olla tietenkin muu kuin edellä mainitut 76 ja 150 mm, jotka ovat tyypillisiä halkaisijoita nykyisten syväpainokoneiden yhteydessä.

Käyttämällä keksinnön mukaisia ratkaisuja syväpainohylsyjen valmistamisessa, voidaan sisähalkaisijaltaan 76 mm hylsyjen käyttöaluetta laajentaa turvallisesti nykyistä nopeampien ja nykyistä leveämpien syväpainokoneiden suuntaan. Keksintömme mukaiset ratkaisut tarjoavat siten vastauksia täysin uusien syväpainokoneiden tuottamille haasteille sekä parantavat nykyisten käytössä olevien syväpainokoneiden taloudellisuutta.

Mainittuja press drying (esim. Condebelt) -materiaaleja voidaan myös käyttää sekarakenteena tavanomaisten hylsykartonkien kanssa tilanteissa, joissa ei tarvita aivan

yhtä suurta kimmomoduulia ja halutaan säästää materiaalia sen mahdollisen rajoitetun saatavuuden tai kustannusten takia. Tällöin esim. lujuuden kannalta strategisissa paikoissa käytetään korkean kimmomoduulin omaavaa rakennenauhaa ja muualla riittävän hyviä tavanomaisia, ts. tunnetun tekniikan mukaisia rakennenauhoja.

Kartonkisen sekarakenteisen kierrehylsyn jäykkyyttä voidaan parantaa konstruoimalla se siten, että rakennenauhoista ainakin yksi on keksinnön mukainen rakennenauha, jonka poikittaissuuntainen kimmomoduuli on ainakin 4500 MPa. Erityisen edullisesti käytetyn rakennenauhan konesuuntainen kimmomoduuli on lisäksi ainakin 7500 MPa. Edullisesti tällaisia keksinnön mukaisia rakennenauhoja on hylsynseinämän vahvuudesta kuitenkin n. 1/5 tai sitä enemmän. Muut mahdolliset rakennenauhat voivat olla tunnetun tekniikan mukaisia rakennenauhoja. Koska keksinnön mukaiset kartonkihylsyn rakennenauhat ovat parempia kuin nykyisin tunnetut rakennenauhat, kannattaa niiden osuus hylsynseinämän paksuudesta ja sijainti hylsynseinämässä optimoida. Kuten aiemmin on todettu, kulkee yleensä käytettyjen hylsyraaka-aineiden laatuluokka ja siten myös valmiiden hylsyjen laatuluokka käsi kädessä niistä maksettavan/saatavan hinnan kanssa, joten tällainen optimointi on täysin perusteltua niin hylsyn valmistajan kuin sitä käyttävän asiakkaankin kannalta.

Keksinnön mukaista rakennenauhaa, siitä valmistettua kartonkihylsyä ja menetelmää kartonkihylsyn jäykkyyden parantamiseksi havainnollistetaan yksityiskohtaisemmin viittaamalla oheisiin piirustuksiin.

Kuviossa 1 on esitetty käyrästön avulla kartonkinauhan nauhakulman α funktiona erilaisista kartonkinauhoista konstruoitujen kartonkihylsyjen kimmomoduulin arvoja,

kuviossa 2 on esitetty käyttämämme nauhakulman α määrittely ja

kuviossa 3 on esitetty kahdella eri kartonkityypillä, eri nauhakulmilla α lasketut hylsyn sisähalkaisijan kokoonpuristuvuudet.

Oheisessa kuviossa 1 on esitetty käyrästön avulla esimerkinomaisesti kartonkinauhan nauhakulman α funktiona (average winding angle°) keksinnön mukaisia kartonkinauhoja hyödyntämällä konstruoitujen paperi-, muovi- ja tekstiiliteollisuudessa käytettävien hylsyjen, esim. syväpainokonehylsyjen kimmomoduulin arvoja verrattuna vastaaviin tunnettuihin tavanomaisiin, paremman lujuusvaatimusluokan hylsyjen kimmomoduulin arvoihin. Kuten jo aiemmin todettiin, tavanomaisesti käytetyillä kierrehylsyn nauhakulmilla, n. 15-35° on rakennenauhan poikkisuunnan kimmomoduulin arvolla erittäin olennainen vaikutus valmiin kierrehylsyn kokonaiskimmomoduuliin. Kartonkinauhan nauhakulman α (average winding angle) määritelmä tämän keksinnön yhteydessä on esitetty kuviossa 2. Nauhakulmalla α (average winding angle) tarkoitetaan kartonkihylsyn akselin suuntaan nähden poikittaisen suunnan ja kartonkinauhan reunan välistä terävää kulmaa α. Kuviossa 1 on esitetty kolmipistekatkoviivalla erästä tyypillistä tunnetun tekniikan mukaista alemman lujuusvaatimusluokan syväpainokonehylsyä. Tasaisella katkoviivalla on puolestaan esitetty erästä tunnetun tekniikan mukaista tyypillistä ylemmän lujuusvaatimusluokan syväpainokonehylsyä. Tässä hylsyssä hylsymateriaalina käytetty kartonki on ollut orientaatiosuhteeltaan mahdollisimman neliömäistä, ts. orientaatiosuhde on ollut lukuarvoltaan pieni. Pistekatkoviivalla on esitetty erästä keksinnön mukaisista rakennenauhoista konstruoitua syväpainokonehylsyä ja ehjällä viivalla toista keksinnön mukaisista rakennenauhoista konstruoitua syväpainokonehylsyä.

Kelattaessa ohuita muovikalvoja tai lankoja kartonkisen kierrehylsyn päälle aiheuttaa kelattava materiaali hylsyyn radiaalisen puristusjännityksen, joka puristus kohdistuu hylsyn sisähalkaisijaan ja aikaansaa siinä muodonmuutoksen, ts. pienentää hylsyn sisähalkaisijaa. Tästä aiheutuu käytännön kelaustilanteissa tietyntyyppisillä kelausistukoilla ongelmia, kun hylsy pyrkii tarttumaan kiinni kelausistukkaan.

Kelattaessa lankoja kartonkisen kierrehylsyn, ts. lankahylsyn päälle, saattaa käytännössä kelausympäristö olla lisäksi vielä kostea. Tämä seikka lisää edelleen taipumusta hylsyn sisämittojen muuttumiselle ja hylsyn kiinnitarttumiselle kelausakseliin.

Olemme havainneet, että käyttämällä keksinnön mukaisia rakennenauhoja tällaisten hylsyjen konstruoinnissa, voidaan hylsyn sisähalkaisijan kokoonpuristumistaipumusta alentaa merkittävästi, kuten oheisesta kuviosta 3 voidaan havaita.

Kuviossa 3 on esitetty kahdella eri kartonkityypillä, eri nauhakulmilla α (average winding angle) lasketut hylsyn sisähalkaisijan kokoonpuristuvuudet. Ympyrällä merkityn nykyisin yleisesti käytetyn kartongin orientaatiosuhde on tässä kokeessa ollut n. 1.6. Tällöin konesuunnan (MD) kimmomoduuli on ollut n. 7000 MPa ja poikkisuunnan (CD) kimmomoduuli on ollut n. 3000 MPa. Kolmiolla merkityn ns. puristuskuivausmenetelmällä valmistetun (esim. ns. Condebelt-kartonki) orientaatiosuhde on tässä kokeessa ollut n. 1.8. Tällöin konesuunnan (MD) kimmomoduuli on ollut n. 11000 MPa ja poikkisuunnan (CD) kimmomoduuli on ollut n. 6000 MPa.

PATENTTIVAATIMUKSET

1. Kartonkihylsyn rakennenauha, **tunnettu** siitä, että rakennenauhan poikittaissuuntainen (CD) kimmomoduuli E on olennaisesti suurempi kuin 4500 MPa.

2. Patenttivaatimuksen 1 mukainen rakennenauha, **tunnettu** siitä, että rakennenauhan poikittaissuuntainen (CD) kimmomoduuli E on suurempi kuin 4800 MPa ja edullisesti suurempi kuin 5000 MPa.

3. Patenttivaatimuksen 1 mukainen rakennenauha, **tunnettu** siitä, että rakennenauhan poikittaissuuntainen (CD) kimmomoduuli E on suurempi kuin 5500 MPa ja edullisesti suurempi kuin 6000 MPa ja erityisen edullisesti yli 6500 MPa.

4. Jonkin edellisen patenttivaatimuksen 1 - 3 mukainen rakennenauha, **tunnettu** siitä, että rakennenauhan konesuuntainen (MD) kimmomoduuli E on lisäksi olennaisesti suurempi kuin 7500 MPa.

5. Jonkin edellisen patenttivaatimuksen 1 - 3 mukainen rakennenauha, **tunnettu** siitä, että rakennenauhan konesuuntainen (MD) kimmomoduuli E on lisäksi olennaisesti suurempi kuin 8000 MPa.

6. Jonkin patenttivaatimuksen 1 - 5 mukainen kartonkihylsyn rakennenauha, **tunnettu** siitä, että rakennenauha on valmistettu jollakin ns. puristuskuivausmenetelmällä (press drying).

7. Jonkin edellisen patenttivaatimuksen mukaisen rakennenauhan sisältävä kartonkihylsy, jonka kartonkihylsyn kimmomoduuli E on ainakin 5000 MPa ja edullisesti yli 5500 MPa ja erityisen edullisesti yli 6000 MPa.

8. Kartonkinen kierrehylsy, **tunnettu** siitä, että kartonkihylsy koostuu rakennenauhoista, joista ainakin yhden rakennenauhan poikkisuuntainen (CD) kimmomoduuli on ainakin 4500 MPa ja edullisesti yli 5000 MPa ja konesuuntainen (MD) kimmomoduuli on ainakin 7500 MPa ja edullisesti yli 8000 MPa.

9. Patenttivaatimuksen 8 mukainen kartonkinen kierrehylsy, **tunnettu** siitä, että kartonkihylsy koostuu rakennenauhoista, joiden kokonaispaksuus hylsyn seinämänvahvuudesta on edullisesti ainakin 1/5 ja joiden poikkisuuntainen (CD) kimmomoduuli on ainakin 4500 MPa ja edullisesti yli 5000 MPa ja konesuuntainen (MD) kimmomoduuli on ainakin 7800 MPa ja edullisesti yli 8000 MPa.

10. Menetelmä kartonkisen kierrehylsyn jäykkyyden parantamiseksi, **tunnettu** siitä, että kartonkihylsy konstruoidaan rakennenauhoista, joista ainakin yhden rakennenauhan poikkisuuntainen (CD) kimmomoduuli on ainakin 4500 MPa ja edullisesti yli 5000 MPa ja konesuuntainen (MD) kimmomoduuli on ainakin 7800 MPa ja edullisesti yli 8000 MPa.

11. Patenttivaatimuksen 10 mukainen menetelmä kartonkisen kierrehylsyn jäykkyyden parantamiseksi, **tunnettu** siitä, että kartonkihylsy konstruoidaan rakennenauhoista, joiden kokonaispaksuus hylsyn seinämänvahvuudesta on edullisesti ainakin 1/5 ja joiden poikkisuuntainen (CD) kimmomoduuli on ainakin 4500 MPa ja edullisesti yli 5000 MPa ja konesuuntainen (MD) kimmomoduuli on ainakin 7800 MPa ja edullisesti yli 8000 MPa.

12. Jonkin edellämainitun patenttivaatimuksen 7 - 9 mukainen kartonkihylsy, **tunnettu** siitä, että kartonkihylsy konstruoidaan rakennenauhoista, joiden konesuunnan (MD) kimmomoduuli on ainakin 9000 MPa.

13. Jonkin patenttivaatimuksen 7 - 9 mukaisen kartonkihylsyn käyttö lankahylsynä.

14. Patenttivaatimuksen 12 mukaisen kartonkihylsyn käyttö lankahylsynä.

15. Jonkin patenttivaatimuksen 7 - 9 mukaisen kartonkihylsyn käyttö ohuiden muovikalvojen kelaushylsynä.

16. Patenttivaatimuksen 12 mukaisen kartonkihylsyn käyttö ohuiden muovikalvojen kelaushylsynä.

17. Patenttivaatimuksen 7 - 9 tai 12 mukaisen kartonkihylsyn käyttö paperiteollisuushylsynä, joka on paksuseinämäinen, seinämänvahvuus H on 10 mm tai yli ja sisähalkaisija yli 70 mm, joita hylsyjä käytetään auki-/kiinnirullausnopeuksilla, jotka ovat vähintään n. 200 m/min (= 3,3 m/s).

18. Patenttivaatimuksen 7 - 9 tai 12 mukainen hylsy, **tunnettu** siitä, että kartonkihylsy on paperiteollisuushylsy, joka on paksuseinämäinen, seinämänvahvuus H on 10 mm tai yli ja sisähalkaisija yli 70 mm, joita hylsyjä käytetään auki/kiinnirullausnopeuksilla, jotka ovat vähintään n. 200 m/min (= 3,3 m/s) ja jonka kartonkihylsyn seinämän keskellä olevan kartonkinauhan nauhanleveys on
kartonkihylsyn sisähalkaisijan ollessa
- alueella 73 mm - 110 mm,
ainakin 185 mm, edullisesti yli 210 mm ja erittäin edullisesti yli 230 mm ja
- alueella 111 mm - 144 mm,
ainakin 205 mm, edullisesti yli 210 mm ja erittäin edullisesti yli 230 mm ja
kartonkihylsyn sisähalkaisijan ollessa

- alueella 145 mm - 180 mm,

ainakin 210 mm, edullisesti yli 250 mm ja erittäin edullisesti välillä 350 mm - 450 mm,

- alueella 181 mm - 310 mm,

ainakin 220 mm, edullisesti yli 250 mm ja erittäin edullisesti välillä 350 mm - 500 mm, mutta

enintään kunkin halkaisijaltaan tietyn mittaisen hylsyn maksimi nauhanleveyden L_{max}, jossa L_{max} = (π) x (hylsyn halkaisija ko. kohdassa).

TIIVISTELMÄ

Esillä olevan keksintö kohdistuu kartonkisen kierrehylsyn rakennenauhaan, jonka poikittaissuuntainen (CD) kimmomoduuli E on olennaisesti suurempi kuin 4500 MPa. Rakennenauhan konesuuntainen (MD) kimmomoduuli E on lisäksi olennaisesti suurempi kuin 7500 MPa (N/mm^2). Tällaisen rakennenauhan sisältävä kierrehylsy on myös keksinnön kohteena. Esillä oleva keksintö kohdistuu lisäksi menetelmään kartonkisen kierrehylsyn jäykkyyden parantamiseksi. Näitä keksinnön mukaisia kartonkihylsyjä voidaan valmistaa käyttämällä hylsyn valmistuksessa joko yksinomaan tai osittain keksinnön mukaisia rakennenauhoja, joihin käytetty kartonki on valmistettu esim. ns. puristuskuivausmenetelmällä (ns. press drying). Puristuskuivausmenetelmään perustuvaa kartonkia voidaan valmistaa esim. erästä tunnettua, ns. Condebelt-prosessia hyödyntävällä kartonkikoneella. Tällaisten hylsyjen käyttö lankahylsynä ja ohuiden muovikalvojen kelaushylsynä on myös keksinnön kohteena.

Fig 1.

T5

19

PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P1399	**FOR FURTHER ACTION** See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/FI98/00061	International filing date *(day/month/year)* 23/01/1998	Priority date *(day/month/year)* 14/02/1997
International Patent Classification (IPC) or national classification and IPC B31C3/00		
Applicant AHLSTRöM ALCORE OY et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 18 sheets.

3. This report contains indications relating to the following items:

   I ☒ Basis of the report
   II ☐ Priority
   III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   IV ☐ Lack of unity of invention
   V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   VI ☐ Certain documents cited
   VII ☐ Certain defects in the international application
   VIII ☒ Certain observations on the international application

Date of submission of the demand 07/09/1998	Date of completion of this report 03.05.99
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. (+49-89) 2399-0 Tx: 523656 epmu d Fax: (+49-89) 2399-4465	Authorized officer Felgenhauer, H-P Telephone No. (+49-89) 2399 2618

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/FI98/00061

I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

1-14	as received on	29/01/1999	with letter of	29/01/1999

Claims, No.:

1-17	as received on	29/01/1999	with letter of	29/01/1999

Drawings, sheets:

1/3-3/3	as originally filed

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1 - 17
	No:	Claims	
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1 - 17
Industrial applicability (IA)	Yes:	Claims	1 - 17
	No:	Claims	

2. Citations and explanations

see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

To section V

1. The following documents have been considered for the purposes of this report:

   D1 ... US-A-5 505 395
   D2 ... Dennis Gunderson "an overview of press-drying, impulse-drying, and Condebelt-drying concepts" in Paperi ja Puu - Paper and Timber Vol. 74 No. 5/1992, page 412 ff.

2. The application does not meet the requirements of Article 6 PCT because the claims are not clear as indicated in section VIII.

3. Furthermore, insofar as the present text can be understood, the subject-matter of claims 1, 7, 9 and 12 - 16 does not involve an inventive step, and therefore does not satisfy the criterion set forth in Article 33(3) PCT.

4.1 The problem underlying the present application (page 7, lines 20 - 32) is, as far as the provision of a structural ply is concerned, to be solved by the structural ply according to claim 1, that is by the definition of two material properties, namely the elasticity modulus in the machine direction and the cross machine direction and by indicating that the structural ply is manufactured with a press drying method.

4.2 A structural ply having the material properties stated in claim 1 is obvious in view of D1 (cf. e.g. claim 1; column 10: table 1) which discloses - in comparison with the subject-matter of claim 1 - a similar kind of structural ply having a higher elasticity modulus in the machine direction (10900 MPa) and a lower one (3660 MPa versus 4500 MPa) in the cross machine direction.

According to D1 it is - as it is the case for the present application - an object to provide a structural ply with improved stiffness properties (column 1, lines 13 - 15; 51 - 55). According to the prior art mentioned in D1 the strength of plies can be increased by "compressing the paperboard during manufacture" (column 1, lines 62 - column 2, line 4). Consequently according to the teaching of D1 stronger, higher density structural plies are to be used in the formation of a core (column 3, lines 51 - 55).

According to D2, which has been filed by the applicant, utilising a press drying method in the manufacturing of a structural ply of the kind concerned leads - in comparison to conventional wet pressing and ring drying - to a significant increase in tensile strength as a function of density (page 413, first paragraph of the middle column).

Thus it comes within regular design practice to apply, in case the modulus of elasticity of a structural ply according to D1 is to be further increased in the cross machine direction, the press drying method defined in claim 1, since from D2 it is known that application of such a method leads to a significant improvement in strength.

The combination of features of claim 1 thus cannot be considered as involving an inventive step in view of D1 and the general technical knowledge as documented by D2. The subject-matter of claim 1 thus does not satisfy the requirement of Article 33 (3) PCT.

4.3 For corresponding reasons the material properties defined by the additional features of claims 2 - 4 and the further definition of the manufacturing method according to claim 5 (cf. D2, e.g. page 415, left column: use of Condebelt process) cannot be considered as leading to subject-matter satisfying the requirement of Article 33 (3) PCT.

4.4 For corresponding reasons and since according to D1 the overall strength of paperboard cores can be improved by employing stronger structural plies (column 1, lines 62 - 65) the cores according to claims 6 - 8, 11, 17, the methods according to claims 9, 10 and the uses of a core according to claims 12 - 16 cannot be considered as satisfying the requirement of Article 33 (3) PCT.

Thereby the features of claims 16, 17 relating to dimensions and the features of claims 8, 10 relating to relative dimensions have been considered as coming, depending on circumstances, within regular design practice since the particular values given do not appear to go beyond known corresponding values (cf. D1, column 5, line 66 - column 6, line 15 for a core used as yarn carrier) in an

inventive manner and since the impact of dimensions on the strength of a core is generally known (cf. e.g. D1, column 1, lines 62 - 65).

To section VIII

1.1 Claim 1 is not clear (Article 6 PCT) since with this claim it is attempted to define a product: a structural ply of a paperboard core

a) defining two material properties (minimum values for the elasticity modulus in machine direction and cross machine direction) and

b) indicating a method (press drying method) used for manufacturing the structural ply.

These parameters cannot clearly define the structure of a structural ply of a paperboard core, since neither the material properties (such as raw material, bonding agent if any, density of structural ply etc.; cf. e.g. page 6, lines 17 - 22) nor the conditions under which the press drying method has to be performed (e.g. pressure, temperature, pressing time) are defined to a sufficient extent.

1.2 The additional features of claims 2 - 5 likewise fail to define the parameters necessary to clearly define a structural ply of a paperboard core.

1.3 For corresponding reasons claims 6 - 8, 11 and 17 concerning a paperboard core, claims 9 - 11 relating to a method of improving the stiffness of a spirally wound paperboard core and claims 12 - 16 concerning the use of a paperboard core are unclear.

1.4 Claims 8 and 10 are unclear since it is indicated that the total thickness of the structural plies is at least 1/5 of the core wall thickness, thereby leaving it completely undefined how the remainder of the core wall thickness is formed.

1.5 The expression "Condebelt" referred to in claim 5 appears to relate to a trademark or tradename and thus does not define a process by technical features (Article 6 PCT).